HW 5: Due March 10

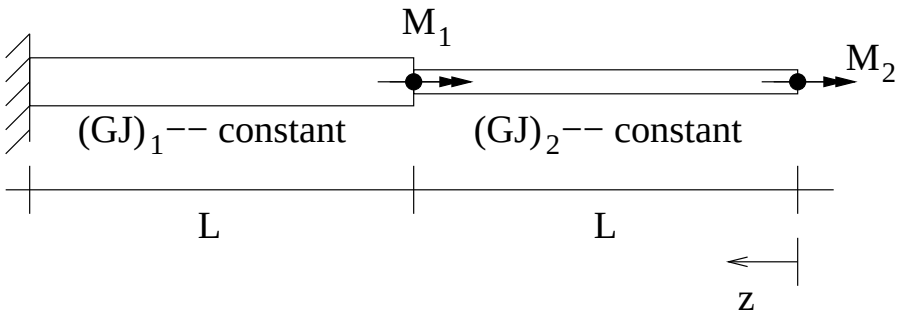
1. Consider a stepped torsion rod with torsional rigidity $(GJ)_1$ for $0 \le z \le L$ and $(GJ)_2$ for $L \le z \le 2L$. The rod is built-in at $z = 0$ and $z = 2L$; it is subject to a point torque of magnitude T_a at $z = L$.

   (a) Find the rotation at $z = L$ using conservation of energy.

   (b) Find the rotation at $z = L$ using the principle of stationary potential energy.

   You should get the same answer for both parts!

2. Use the principle of stationary potential energy to find the rotations at the two load points for the stepped rod shown below



3. Consider a cantilever beam with a uniform distributed load $q(x) = q_o$. Assume a deflection solution of the form $v(x) = Cx^2$ and determine an *approximate* solution by minimizing the potential energy. Compare the tip deflection to the exact solution.

4. Consider a round elastic bar of length L with constant shear modulus, G, and polar moment of inertia, J. The bar is built-in at both ends and subject to a spatially varying distributed torsional load

$$t(z) = p\frac{z}{L}\,,$$

   where p is a constant with units of torque per unit length. Find an *approximate* expression for the the rotation field using the principle of stationary potential energy. Compare your result to the exact solution.